LMS Seminar series 2024 – 25

Analysis-suitable B-Spline models from digital images

Speaker: Jean-Charles Passieux, INSA Toulouse
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Abstract

Cellular material, namely foams or lattices, are characterized by complex architecture where the material is concentrated in small spans or thin webs, at an intermediate scale between the constituents and the structure. This particularity provides these materials with remarkable specific properties. The recent development of new manufacturing processes (especially additive manufacturing), pushes these materials to a new stage. Many open questions are stirring up the scientific community, in particular, multiscale modelling, characterization of the associated parameters, fast and accurate simulation, and geometric hazard. In essence, foams have a random architecture, thus their geometry is locally variable and unknown. For lattices, defects inherent to additive manufacturing processes are known to introduce non-negligible geometric biases. In view of identifying the mechanical properties, the geometric characterization of the sample is therefore of paramount importance to build a digital mechanical twin associated to each individual tested sample. In this talk, we present different types of image-based modelling techniques and how do they help to bridge mechanical experiments and numerical simulations. We will then focus on techniques that build an explicit geometry based on splines and the corresponding control point fitting procedure. In order to achieve the lightest possible model, and given the morphology of the materials considered, the method aims at building explicit isogeometric beams and isogeometric volumetric models. These models are called analysis-suitable in the sense that they are ready for mechanical simulations.

About the speaker

JC Passieux is currently professor of computational mechanics at INSA Toulouse and researcher in MOON team at Clement Ader Institute (ICA UMR 5312 CNRS-INSA-UPS-Supaero-Mines Albi) in Toulouse, France. With a background in computational mechanics (PhD at ENS Paris-Saclay in 2008), he has been developing numerical methods in domain decomposition, time-space multiscale, multigrid, XFEM, model order reduction, isogeometric analysis with application to nonlinear mechanics, fracture, multiscale modeling of materials and structures, with special attention to the level of invasiveness and to the minimization of numerical complexity. In addition to numerical methods for direct simulations, J.C. Passieux has also been developing tools for optimization and inverse problems in the field of experimental and computational photomechanics. He has contributed to the development of finite element based and global digital image correlation (DIC) methods, identification from digital images, image-based models and data assimilation. He is the main developer of the FE-DIC opensource python Library Pyxel. He obtained several funding supports through collaborative projects (4 ANR projects and direct collaborations with AIRBUS, SELMER, DGA, IRT St EXUPERY). He was co-chair of the international conference Photomechanics 2018 in Toulouse and is member of the board of PhotoMechanicsAssociation (PMa) and Computational Structural Mechanics Association (CSMA).

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